
MODELING THE INFLUENCE OF DIGITAL AND AI LITERACY ON GENERATIVE AI USE AND CAREER PERCEPTION

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Abstract

The rapid diffusion of Generative Artificial Intelligence (GenAI) is reshaping learning practices and students' perceptions of future careers in higher education. This study examines the roles of digital literacy and AI literacy in influencing GenAI usage and future career perception among university students in Samarinda, Indonesia. A quantitative survey of 426 students from public and private universities was analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 4.0. The results show that students have moderately high levels of digital literacy and AI literacy, while GenAI usage is widespread, particularly for text-based activities such as writing and editing. Digital literacy strongly influences AI literacy and GenAI usage but does not directly affect future career perception. In contrast, AI literacy is the main determinant of positive career perception and serves as a key mediator linking digital competence to future-oriented outcomes. The model explains approximately 39% of the variance in future career perception and 40% of the variance in AI literacy, indicating moderate explanatory power. These findings highlight the importance of structured AI literacy development in higher education to support responsible GenAI adoption and strengthen students' readiness for an AI-driven labor market.

Keywords: Digital literacy, AI literacy, Generative AI, higher education, future career perception

Abstrak

Difusi cepat Kecerdasan Buatan Generatif (GenAI) telah mengubah praktik pembelajaran dan memengaruhi persepsi mahasiswa terhadap karier masa depan. Studi ini menganalisis peran literasi digital dan literasi AI dalam memengaruhi penggunaan GenAI serta persepsi karier mahasiswa di Samarinda, Indonesia. Penelitian menggunakan survei kuantitatif terhadap 426 mahasiswa dari perguruan tinggi negeri dan swasta, kemudian dianalisis dengan Partial Least Squares Structural Equation Modeling (PLS-SEM) menggunakan SmartPLS 4.0. Hasil menunjukkan bahwa mahasiswa memiliki tingkat literasi digital dan literasi AI yang cukup tinggi, dengan penggunaan GenAI yang luas, terutama untuk aktivitas berbasis teks seperti menulis dan mengedit. Literasi digital berpengaruh kuat terhadap literasi AI dan penggunaan GenAI, tetapi tidak berpengaruh langsung terhadap persepsi karier. Sebaliknya, literasi AI menjadi faktor utama yang membentuk persepsi karier positif dan

berperan sebagai mediator penting antara kompetensi digital dan kesiapan masa depan. Model menjelaskan sekitar 39% varians persepsi karier dan 40% varians literasi AI. Temuan ini menegaskan pentingnya penguatan literasi AI secara terstruktur dalam pendidikan tinggi.

Kata Kunci: literasi digital, literasi AI, generatif AI, pendidikan tinggi, Persepsi Karier Masa Depan

INTRODUCTION

The rapid development of Artificial Intelligence (AI) has increasingly transformed various aspects of human life, including higher education. The emergence of Generative Artificial Intelligence (GenAI), such as ChatGPT, Copilot, Meta-AI, and DALL-E, has introduced new ways for students to access information, produce academic content, complete assignments, and interact with learning materials. GenAI refers to AI systems capable of generating new content, including text, images, audio, and other forms of output, based on large datasets and deep learning architectures (World Economic Forum, 2023). In the context of higher education, this technology is no longer only a technical innovation but has become part of students' academic practices and future career preparation.

In Indonesia, the use of AI-based applications has begun to expand, although its adoption in education remains uneven. The 2024 Indonesia Internet Survey by the Asosiasi Penyelenggara Jasa Internet Indonesia (APJII) reported that 24.7% of Indonesian internet users had used AI-based tools for various activities, while only 5.40% reported AI use in the education sector (Asosiasi Penyelenggara Jasa Internet Indonesia, 2024). This indicates that although AI technologies are increasingly recognized, their educational use is still developing. At the higher education level (Diktiristek, 2024), highlights several potential benefits of GenAI, including personalized learning, wider access to learning resources, adaptive assessment, increased student engagement, collaborative learning, and support for lecturers' instructional tasks. Research by Liliana et al. (2023) also found that students have used GenAI for generating informational content, supporting learning activities, facilitating work tasks, and assisting research.

Recent empirical findings show that students' use of GenAI is growing rapidly, but the level of understanding, optimization, and responsible use remains varied. KOPERNIK (2023) reported that many respondents perceived GenAI as beneficial and promising, although familiarity and daily use were not evenly distributed. In the Indonesian student context, Simaremare et al. (2024) found that most students in North Sumatra understood and used GenAI to support learning activities, while Hartanto and Rohmah (2024) reported that 86.21% of respondents used GenAI to complete academic tasks, with some respondents indicating daily reliance on such tools. These findings suggest that GenAI has become part of students' learning behavior, yet they do not fully explain how students' literacy levels influence their use of GenAI or how this use shapes their perceptions of future careers.

Previous studies have shown both positive and negative consequences of GenAI utilization in education. On the positive side, GenAI can facilitate access to learning resources, provide immediate feedback, support academic writing, overcome language barriers, and

enhance personalized learning experiences (Fan et al., 2024; Mohamed et al., 2024). A meta-analysis by Sun & Zhou (2024), also found that GenAI use is associated with moderate improvements in academic performance. However, concerns remain regarding dependence on AI, reduced critical thinking, academic integrity, information reliability, bias, privacy, and ethical use. Waluyo and Kusumaswati (2024) emphasized the importance of explicit guidelines regarding generative AI misuse and ethical considerations. Many aspects of GenAI utilization in higher education—whether from the learners’ perspective, instructors’ practices, or institutional policies—remain underexplored. Meanwhile, Fakhri et al. (2024) similarly found that although students respond positively to ChatGPT, some remain concerned about dependence on technology and the possible decline of critical thinking skills.

These mixed findings indicate that the adoption of GenAI in higher education cannot be understood only from the perspective of tool usage. Students’ ability to use GenAI productively and responsibly depends on their digital literacy and AI literacy. Digital literacy provides the basic competence to access, evaluate, communicate, and create information using digital technologies, while AI literacy enables students to understand AI concepts, recognize its limitations, evaluate AI-generated content, and use AI tools ethically. However, many previous studies still treat digital literacy, AI literacy, and GenAI use as separate issues. The specific relationship between digital literacy and AI literacy, and how both influence GenAI use and future-oriented perceptions, remains insufficiently examined.

This research gap becomes more important when viewed from the perspective of students’ future careers. GenAI is not only changing academic activities but also reshaping the labor market, workplace competencies, and students’ expectations about employability. Existing research has widely discussed the impact of AI on automation, job displacement, and workforce transformation, but fewer studies have examined how students themselves interpret GenAI in relation to their own career paths, competencies, and future readiness. Understanding students’ career perception is important because it reflects their confidence, awareness, and preparedness to enter an AI-driven labor market.

In the local context, research on GenAI use among university students in Samarinda remains limited. Rahman & Afandi (2024) found that responsibility and ethical issues in GenAI use remain underexplored at *Universitas Islam Negeri Samarinda*. However, broader empirical evidence across higher education institutions in Samarinda is still scarce. This condition creates a need for a study that not only describes students’ use of GenAI, but also explains the structural relationships among digital literacy, AI literacy, GenAI use, and future career perception.

Therefore, this study aims to examine the level of digital literacy and AI literacy among university students in Samarinda, analyze the influence of these literacies on GenAI use, and investigate how GenAI use and AI literacy shape students’ perceptions of their future careers. By using Partial Least Squares Structural Equation Modeling (PLS-SEM), this study develops an integrated model that captures both direct and indirect pathways among the constructs. Theoretically, this study contributes to the development of literacy-based models of GenAI adoption in higher education. Practically, the findings are expected to provide insights for

universities in designing AI literacy programs, digital competence development, and career preparation strategies that are relevant to an AI-driven labor market..

THEORY AND HYPOTESIS DEVELOPMENT

Digital literacy is a multidimensional competence that enables individuals to access, manage, evaluate, communicate, and create information using digital technologies. Law et al. (2018), as cited in the UNESCO framework, emphasize that digital literacy involves not only technical skills but also cognitive, communicative, and ethical dimensions. Similarly, van Laar et al. (2020) describe digital literacy as a combination of technical, informational, communicative, and problem-solving skills required to function effectively in digital environments. In higher education, digital literacy becomes a fundamental competence because students are increasingly required to search for information, evaluate digital content, collaborate online, and use digital tools for academic and professional purposes.

AI literacy develops from this broader foundation of digital literacy but focuses more specifically on students' ability to understand, use, evaluate, and critically reflect on Artificial Intelligence. Ng et al. (2021a, 2021b) argue that AI literacy includes understanding basic AI concepts, recognizing AI applications, evaluating AI limitations, and considering the ethical and social implications of AI use. Long and Magerko (2020) also emphasize that AI literacy is important for enabling non-experts to interact with AI systems more effectively and responsibly. Therefore, students with stronger digital literacy are expected to have better readiness to develop AI literacy because they already possess the basic digital skills needed to access, operate, and evaluate AI-based tools. Accordingly, this study proposes the following hypothesis:

H1: Digital Literacy has a positive effect on AI Literacy.

Generative Artificial Intelligence (GenAI) represents a major development in AI applications because it enables users to produce new content, including text, images, audio, code, and other digital outputs. Generative AI (GenAI) represents a major development in AI applications because it enables users to produce new content, including text, images, audio, code, and other digital outputs. In higher education, GenAI can support academic writing, information search, feedback generation, translation, presentation preparation, and other learning-related activities (Diktiristek, 2024; Fui-Hoon Nah et al., 2023). However, the ability to use GenAI productively depends not only on access to tools but also on students' literacy in understanding how AI works, how to evaluate AI-generated outputs, and how to use the technology ethically.

AI literacy is therefore expected to influence both students' actual use of GenAI and their perception of future career opportunities. Students who understand AI concepts, limitations, ethical risks, and practical applications are more likely to use GenAI meaningfully in academic tasks. Previous studies suggest that AI literacy strengthens users' ability to interact with AI systems, evaluate algorithmic outputs, and apply AI tools in learning and work-related contexts (Long & Magerko, 2020; Ng et al., 2021b, 2021a; UNESCO, 2024). In addition, students with higher AI literacy may perceive the future labor market more positively because they feel more

prepared to adapt to AI-driven changes in work processes, skills demand, and employability. Thus, this study proposes the following hypotheses:

H2: AI Literacy has a positive effect on Future Career Perception.

H3: AI Literacy has a positive effect on GenAI Use.

Digital literacy is also expected to directly influence GenAI Use. Students who are more familiar with digital devices, online platforms, information search, digital content creation, and online collaboration may be more capable of accessing and experimenting with GenAI tools. Prior studies indicate that digital competence supports technology adoption and learning behavior in digital environments (Park, 2025; Van Laar et al., 2020; Yang et al., 2025). In the context of GenAI, digital literacy provides the operational foundation for students to identify relevant tools, formulate prompts, assess digital outputs, and integrate AI-generated content into academic activities. Therefore, this study proposes the following hypothesis:

H4: Digital Literacy has a positive effect on GenAI Use.

GenAI Use may also shape students' perceptions of their future careers. The increasing use of AI tools in education and the workplace has made students more aware of the changing nature of professional competencies. GenAI can expose students to new forms of productivity, problem solving, content creation, and decision support, which may influence how they view their future employability. Studies by Ferhataj et al. (2025), Santos-Jaén et al. (2025) and Colón-Aguirre and Bright (2025) show that students increasingly recognize AI as an important factor in future employment and professional development. However, other studies also show that students may experience uncertainty, anxiety, or concern about job displacement, ethical issues, and the adequacy of their preparation for an AI-driven labor market (Badulescu et al., 2024; Siraj et al., 2025; Wang & Gao, 2025). These findings suggest that GenAI Use can contribute to students' career perception, either by increasing readiness or by raising awareness of future challenges. Thus, this study proposes the following hypothesis:

H5: GenAI Use has a positive effect on Future Career Perception.

Digital literacy may also influence Future Career Perception directly. Students with stronger digital literacy may feel more confident in adapting to digital transformation, online work environments, and technology-based professional demands. Perceived employability is often related to students' assessment of their own skills, academic readiness, and ability to respond to changing labor market needs (Pratiwi et al., 2025). In the AI era, digital literacy may strengthen students' belief that they can adapt to emerging technologies and remain competitive in future careers. Therefore, this study proposes the following hypothesis:

H6: Digital Literacy has a positive effect on Future Career Perception.

The conceptual framework of this study integrates Digital Literacy, AI Literacy, GenAI Use, and Future Career Perception into one structural model. The model assumes that Digital Literacy functions as a foundational competence that supports AI Literacy and GenAI Use. AI Literacy then acts as a more specific competence that enables students to understand and use GenAI more effectively, while also shaping their perceptions of future career readiness. GenAI

Use is positioned as a behavioral construct that may connect literacy-based competencies with students' future-oriented career perceptions.

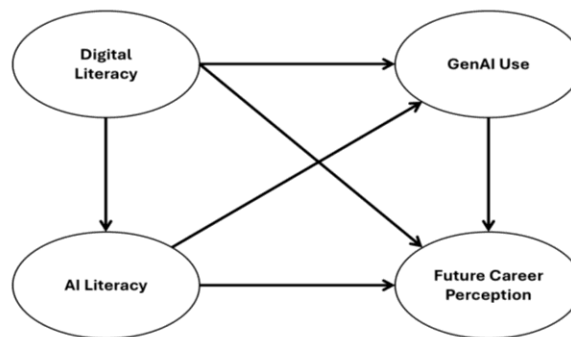


Figure 1. Research Framework

In addition to direct effects, this study also examines several indirect pathways. These pathways are important because the influence of Digital Literacy on Future Career Perception may not occur only through a direct relationship, but also through AI Literacy and GenAI Use. Similarly, AI Literacy may influence Future Career Perception indirectly through GenAI Use. The proposed indirect hypotheses are as follows:

H7: Digital Literacy has an indirect effect on Future Career Perception through AI Literacy and GenAI Use.

H8: Digital Literacy has an indirect effect on Future Career Perception through AI Literacy.

H9: Digital Literacy has an indirect effect on GenAI Use through AI Literacy.

H10: AI Literacy has an indirect effect on Future Career Perception through GenAI Use.

H11: Digital Literacy has an indirect effect on Future Career Perception through GenAI Use.

Overall, this conceptual model explains how general digital competence, specific AI-related competence, and actual GenAI usage behavior interact in shaping students' perceptions of their future careers. The model is tested using Partial Least Squares Structural Equation Modeling (PLS-SEM) to evaluate both the direct and indirect relationships among the constructs.

RESEARCH METHODS

This study used a quantitative cross-sectional survey design with descriptive and explanatory analysis. Descriptive analysis was used to describe respondents' digital literacy, AI literacy, GenAI use, and future career perception, while explanatory analysis was applied to examine the structural relationships among the constructs. The study was conducted among university students in Samarinda City, East Kalimantan, Indonesia.

The population consisted of active students enrolled in public and private higher education institutions in Samarinda in 2025, including diploma, undergraduate, master's, and doctoral programs. Based on data from LLDIKTI Region XII and the Higher Education Database (PDDIKTI), the total student population in Samarinda was approximately 68,300 students from

26 universities and colleges. The minimum sample size was calculated using Slovin's formula with a 5% margin of error, resulting in a minimum requirement of 398 respondents. Data were collected through an online questionnaire distributed via Google Forms. A total of 535 responses were obtained, and after screening for completeness and response consistency, 426 valid responses were retained for analysis. This final sample exceeded the minimum sample requirement.

The research instrument was developed as a structured questionnaire using a five-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. The questionnaire consisted of 72 items measuring four constructs: Digital Literacy, AI Literacy, GenAI Use, and Future Career Perception. Digital Literacy and AI Literacy were developed as multidimensional constructs based on prior literature and international frameworks, while GenAI Use and Future Career Perception were measured as behavioral and perceptual constructs. Before the full survey was administered, a pilot test involving 10 undergraduate students was conducted to assess item clarity, wording, and readability. Several minor revisions were made based on the pilot test feedback before the questionnaire was finalized.

Table 1. Dimensions and Questionnaire Items

No	Variable	Dimensions / Indicator Coverage	No. of Items	Reference
1	Digital Literacy	Access and device use; data and information literacy; communication and collaboration; digital content creation; safety and privacy awareness	23	Avinç & Doğan, 2024; Bawden, 2008; UNESCO, 2019
2	AI Literacy	Basic AI concepts; functional understanding of AI; ethical and social awareness; AI tool usage skills; critical thinking on AI	23	Chiu et al., 2024; Long & Magerko, 2020; Ng et al., 2021a, 2021b; UNESCO, 2024; Stolpe & Hallström, 2024
3	GenAI Use	Use of GenAI tools for academic, learning, writing, information-seeking, and task-support activities	16	Chergarova et al., 2023; Zhang et al., 2025; Diktiristek, 2024
4	Future Career Perception	Students' perceptions of AI-related career readiness, employability, and future	10	Badulescu et al., 2024; Kong et al., 2024; Savickas,

No	Variable	Dimensions / Indicator Coverage	No. of Items	Reference
		professional opportunities		1994
	Total Items		72	

Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 4.0. PLS-SEM was selected because the study aimed to examine a predictive structural model involving several latent constructs and both direct and indirect relationships. The analysis was conducted in two stages. First, the measurement model was evaluated to assess indicator reliability, internal consistency reliability, convergent validity, and discriminant validity using outer loading, Cronbach's Alpha, composite reliability, average variance extracted (AVE), and the heterotrait-monotrait ratio (HTMT). Second, the structural model was assessed by examining collinearity, path coefficients, t-statistics, p-values, coefficient of determination (R^2), effect size (f^2), predictive relevance (Q^2), and model fit. Bootstrapping was used to test the significance of the hypothesized direct and indirect effects, while blindfolding was used to assess predictive relevance.

RESEARCH RESULTS AND DISCUSSION

Respondent Profil and GenAI Use

This section presents the empirical findings of the study, including the descriptive profile of respondents, the measurement model assessment, the structural model assessment, and the interpretation of direct and indirect relationships among the constructs. A total of 426 valid responses were analyzed after the screening process.

The respondents represented students from various higher education institutions and academic disciplines in Samarinda. The sample was dominated by undergraduate students and students in the 20–23 age range, indicating that most respondents were in an active stage of academic and career preparation. The respondent profile also showed cross-disciplinary representation, including students from information technology, business, social sciences, agriculture, and other fields. This diversity is important because GenAI use is no longer limited to technology-related programs but has increasingly become part of broader academic practices.

The descriptive results show that students had relatively stable access to digital technology. Most respondents accessed the internet primarily from home, while a smaller proportion accessed it from campus and other public facilities. In terms of internet service, Telkomsel was the dominant mobile provider, and IndiHome was the most frequently used fixed internet service. These findings suggest that most respondents had sufficient digital access to support online learning and the use of AI-based tools.

Table 2. Summary of Descriptive Findings

Aspect	Main Result	Interpretation
Valid respondents	426 students	Final sample exceeded the

Aspect	Main Result	Interpretation
Main internet access location	Home: 80.28%; campus: 11.27%	minimum sample requirement Students mostly accessed digital learning resources from home
Common monthly internet expenditure	IDR 50,000–100,000: 35.7%	Most students had regular internet spending
Dominant mobile provider	Telkomsel: 48.8%	Mobile internet remained important for student connectivity
Dominant fixed internet provider	IndiHome: 55.2%	Many students had access to home internet services
More than five GenAI tools used	156 students; 36.6%	Students tended to explore multiple GenAI platforms
Single GenAI tool used	83 students; 19.5%	Some students relied on one main platform
No GenAI use	3 students; 0.7%	Almost all respondents had used GenAI
Main GenAI purpose	Text development/editing: 284 students; 66.7%	GenAI use was mainly text-based
Digital Literacy score	Mean = 3.9; range = 1.3–5.0	Moderately high perceived digital literacy
AI Literacy score	Mean = 3.9; range = 1.3–5.0	Moderately high perceived AI literacy

The findings indicate that GenAI use was already widespread among university students in Samarinda. Only a very small proportion of respondents reported not using GenAI, suggesting that GenAI has become part of students' academic activities. The dominant use of GenAI for text development and editing also confirms that students primarily engage with GenAI as a learning and academic writing support tool. This pattern is consistent with the current use of GenAI in higher education, where students commonly use AI tools to search for information, summarize content, improve writing, translate text, and support academic tasks.

The average scores of both Digital Literacy and AI Literacy were 3.9 on a five-point Likert scale, indicating moderately high perceived literacy levels among respondents. However, these results should be interpreted carefully. High self-perceived literacy may reflect students' operational confidence in using digital tools and AI applications, but it does not necessarily indicate advanced critical, ethical, or evaluative competence. This distinction is important because responsible GenAI use requires not only access and technical ability but also the

capacity to evaluate AI-generated content, recognize limitations, avoid overdependence, and apply ethical judgment.

Nevertheless, high digital literacy scores in this study should be interpreted cautiously, as they primarily reflect operational and functional confidence rather than advanced critical or ethical digital competencies. This finding is consistent with previous studies in Asian higher education contexts, which report strong technical proficiency alongside weaker critical evaluation skills (Islamia & Arif, 2024; Reddy et al., 2020). Despite the overall moderate-to-high literacy levels, a small subgroup of students reported relatively low digital and AI literacy. This finding indicates that literacy development is not evenly distributed and that certain students may face challenges in effectively engaging with AI-enabled learning environments.

Overall, the respondent profile—characterized by young age, undergraduate dominance, stable internet access, and cross-disciplinary representation—helps explain the moderately high digital literacy observed. These conditions provide a foundational base for the development of more advanced competencies, particularly AI literacy, which is examined in the subsequent discussion.

Measurement Model Assessment

The measurement model was evaluated to ensure that the constructs met the required criteria for reliability and validity. At the initial stage, indicators with outer loading values below 0.70 were removed to improve indicator reliability. After this purification process, 11 indicators were retained for Digital Literacy, 16 indicators for AI Literacy, 9 indicators for GenAI Use, and 6 indicators for Future Career Perception. This process ensured that only indicators with sufficient contribution to their respective latent constructs were included in the final model.

Table 2. Construct Reliability and Convergent Validity Measures for Each Latent Variable

Construct	Cronbach's Alpha	Composite Reliability (rho_a)	Composite Reliability (rho_c)	Average Variance Extracted (AVE)
AI Literacy	0.957	0.958	0.961	0.608
Digital Literacy	0.920	0.927	0.932	0.555
Future Career Perceptions	0.854	0.863	0.891	0.579
GenAI Use	0.903	0.914	0.920	0.560

Referring to Hair (2014) All constructs met the recommended reliability and convergent validity criteria. Cronbach's Alpha values ranged from 0.854 to 0.957, while composite reliability values were also above the 0.70 threshold. The AVE values for all constructs exceeded 0.50, indicating that each construct explained more than half of the variance of its retained indicators. These results confirm that the constructs had adequate internal consistency and convergent validity.

Discriminant validity was assessed using the Heterotrait-Monotrait Ratio (HTMT). The HTMT values ranged from 0.428 to 0.657, which were below the conservative threshold of 0.85. This indicates that the constructs were empirically distinct from one another and suitable for further structural model analysis.

Table 3. Heterotrait-Monotrait (HTMT) Ratio of Correlations Among Constructs

Construct	Heterotrait-Monotrait Ratio
Digital Literacy ↔ AI Literacy	0.647
Future Career Perceptions ↔ AI Literacy	0.657
Future Career Perceptions ↔ Digital Literacy	0.468
GenAI Use ↔ AI Literacy	0.452
GenAI Use ↔ Digital Literacy	0.593
GenAI Use ↔ Future Career Perceptions	0.428

Collinearity was also examined before testing the structural relationships. The outer model VIF values ranged from 1.39 to 3.49, while the inner model VIF values ranged from 1.00 to 1.97. Since all values were below the recommended threshold, multicollinearity was not a concern in the model.

Structural Model Assessment and Hypothesis Testing

The structural model was assessed by examining path coefficients, t-statistics, p-values, explanatory power, effect size, predictive relevance, and model fit. The direct effect results are presented in Table 5.

Table 5. Direct Effect Hypothesis Testing

Hypothesis	Relationship	Original Sample (O)	T- Statistics	P- Values	Path Significance	Hypothesis Result
H1	Digital Literacy → AI Literacy	0.635	23.951	0.000	Significant	Accepted
H2	AI Literacy → Future Career Perception	0.527	11.087	0.000	Significant	Accepted
H3	AI Literacy → GenAI Use	0.162	2.769	0.006	Significant	Accepted
H4	Digital Literacy → GenAI Use	0.452	8.051	0.000	Significant	Accepted
H5	GenAI Use → Future Career Perception	0.135	2.257	0.024	Significant	Accepted
H6	Digital Literacy → Future Career Perception	0.034	0.669	0.504	Not	Rejected

Hypothesis	Relationship	Original Sample (O)	T- Statistics	P- Values	Path Significance	Hypothesis Result
	Future Career Perception				Significant	

The results show that Digital Literacy had a strong and significant effect on AI Literacy ($\beta = 0.635$, $p < 0.001$), supporting H1. This finding confirms that students' general digital competence serves as an important foundation for developing more specific AI-related literacy. Students who are more capable of accessing, evaluating, communicating, and creating digital information are more likely to understand AI concepts, AI tools, and ethical considerations in AI use.

AI Literacy also had a significant effect on Future Career Perception ($\beta = 0.527$, $p < 0.001$), supporting H2. This was one of the strongest relationships in the model, indicating that students' understanding of AI plays a central role in shaping their confidence and outlook toward future careers. Students with higher AI literacy may feel more prepared to face changes in the labor market, adapt to AI-supported work environments, and recognize AI-related opportunities.

The effect of AI Literacy on GenAI Use was also significant ($\beta = 0.162$, $p = 0.006$), supporting H3. However, the coefficient was relatively smaller than other significant paths. This suggests that AI literacy contributes to GenAI use, but it may not be the only factor driving students' use of GenAI tools. Students may also use GenAI because of accessibility, peer influence, academic task demands, or ease of use, even when their conceptual understanding of AI is still developing.

Digital Literacy had a significant effect on GenAI Use ($\beta = 0.452$, $p < 0.001$), supporting H4. This indicates that students with stronger digital literacy are more likely to use GenAI tools in academic activities. Digital literacy helps students identify suitable platforms, formulate prompts, evaluate outputs, and integrate AI-generated content into learning tasks. This finding supports the view that practical digital competence remains an important condition for adopting AI-based tools.

GenAI Use had a significant but relatively weak effect on Future Career Perception ($\beta = 0.135$, $p = 0.024$), supporting H5. This suggests that actual engagement with GenAI tools contributes to students' career perceptions, although its influence is smaller than AI Literacy. Using GenAI may increase students' awareness of how AI can support productivity and future work tasks, but career perception appears to depend more strongly on deeper AI-related understanding than on tool use alone.

Digital Literacy did not have a significant direct effect on Future Career Perception ($\beta = 0.034$, $p = 0.504$), leading to the rejection of H6. This finding is important because it shows that general digital competence alone is not sufficient to shape students' perceptions of future careers. In the AI-driven labor market, students may need more specific AI literacy to translate digital competence into career confidence and future readiness.

Indirect Effect Analysis

The study also examined indirect effects to understand whether AI Literacy and GenAI Use mediated the relationships among constructs. The results are presented in Table 6.

Table 6. Specific Indirect Effects (Bootstrapping Results)

Hypothesis Code	Indirect Path Relationship	Original Sample (O)	T Statistics	P Values	Result	Hypothesis Decision
H7	Digital Literacy → AI Literacy → GenAI Use → Future Career Perception	0.014	1.837	0.066	Not Significant	Rejected
H8	Digital Literacy → AI Literacy → Future Career Perception	0.335	10.174	0.000	Significant	Accepted
H9	Digital Literacy → AI Literacy → GenAI Use	0.103	2.734	0.006	Significant	Accepted
H10	AI Literacy → GenAI Use → Future Career Perception	0.022	1.847	0.065	Not Significant	Rejected
H11	Digital Literacy → GenAI Use → Future Career Perception	0.061	2.119	0.034	Significant	Accepted

The indirect effect results highlight the central role of AI Literacy as a mediator. H8 was supported, showing that Digital Literacy significantly influenced Future Career Perception through AI Literacy ($\beta = 0.335$, $p < 0.001$). This means that students' digital literacy contributes to their future career perception mainly when it is transformed into AI literacy. In other words, digital skills become more meaningful for career readiness when students are also able to understand and evaluate AI-related technologies.

H9 was also supported, indicating that Digital Literacy influenced GenAI Use through AI Literacy ($\beta = 0.103$, $p = 0.006$). This finding suggests that AI literacy helps convert general digital competence into actual GenAI usage behavior. Students with digital skills may be more

capable of accessing AI tools, but AI literacy strengthens their ability to use these tools more purposefully.

H11 was supported as well, showing that Digital Literacy indirectly influenced Future Career Perception through GenAI Use ($\beta = 0.061$, $p = 0.034$). This indicates that students with stronger digital literacy are more likely to use GenAI, and this use may contribute to how they perceive future career opportunities. However, the size of this effect was smaller than the mediation through AI Literacy, reinforcing the idea that conceptual and critical understanding of AI is more important than tool use alone.

In contrast, H7 and H10 were not supported. The serial mediation path from Digital Literacy to Future Career Perception through AI Literacy and GenAI Use was positive but not significant ($\beta = 0.014$, $p = 0.066$). Similarly, the indirect effect of AI Literacy on Future Career Perception through GenAI Use was not significant ($\beta = 0.022$, $p = 0.065$). These findings suggest that GenAI Use does not function as the dominant mediator between AI Literacy and Future Career Perception. Students' career perception appears to be shaped more directly by AI Literacy than by the frequency or extent of GenAI tool use.

Model Explanatory Power, Effect Size, and Predictive Relevance

The explanatory and predictive quality of the model was assessed using R^2 , adjusted R^2 , f^2 , Q^2 , and SRMR. The results are summarized in Table 7.

Table 7. Model Quality Summary

Endogenous Construct	R-Square	Adjusted R-Square	Q^2	Main Effect Size Interpretation
AI Literacy	0.404	0.402	0.240	Digital Literacy had a large effect ($f^2 = 0.677$)
GenAI Use	0.323	0.320	0.172	Digital Literacy had a moderate effect ($f^2 = 0.180$); AI Literacy had a small effect ($f^2 = 0.023$)
Future Career Perceptions	0.389	0.385	0.212	AI Literacy had a moderate effect ($f^2 = 0.265$); GenAI Use had a small effect ($f^2 = 0.020$); Digital Literacy had a negligible direct effect ($f^2 = 0.001$)

The R^2 results indicate that the model explained 40.4% of the variance in AI Literacy, 32.3% of the variance in GenAI Use, and 38.9% of the variance in Future Career Perception. These values suggest moderate explanatory power, particularly for AI Literacy and Future Career Perception. The adjusted R^2 values were only slightly lower than the R^2 values, indicating that the model remained stable after accounting for the number of predictors.

The effect size results provide further insight into the relative importance of each predictor. Digital Literacy had a large effect on AI Literacy, confirming its foundational role in AI literacy development. Digital Literacy also had a moderate effect on GenAI Use, indicating that practical digital competence supports students' adoption of GenAI tools. AI Literacy had a moderate effect on Future Career Perception, making it the most important predictor of students' career-related perceptions. By contrast, Digital Literacy had a negligible direct effect on Future Career Perception, which is consistent with the rejected direct hypothesis H6.

The Q^2 values were above zero for all endogenous constructs, with AI Literacy ($Q^2 = 0.240$), Future Career Perception ($Q^2 = 0.212$), and GenAI Use ($Q^2 = 0.172$) showing predictive relevance. These results indicate that the model has an acceptable ability to predict the key endogenous constructs.

The SRMR value of 0.080 indicates an acceptable model fit, suggesting that the proposed PLS-SEM model is adequate for explaining the relationships among the constructs. Therefore, the proposed structural model can be considered adequate for explaining the relationships among Digital Literacy, AI Literacy, GenAI Use, and Future Career Perception.

Discussion

Overall, the findings show that Digital Literacy, AI Literacy, and GenAI Use are interconnected but have different roles in shaping students' future career perception. Digital Literacy serves as the foundation for AI Literacy and GenAI Use, but it does not directly shape Future Career Perception. This suggests that general digital competence alone is not enough to make students feel prepared for an AI-driven labor market. Students need more specific AI-related understanding to connect their digital skills with future career opportunities.

AI Literacy emerged as the most important construct in the model. It significantly influenced both GenAI Use and Future Career Perception, and it also mediated the relationship between Digital Literacy and Future Career Perception. This finding highlights the importance of AI literacy development in higher education. Students need to understand not only how to use AI tools, but also how AI works, what its limitations are, how to evaluate AI-generated content, and how to apply AI responsibly. Without this literacy, students may use GenAI frequently but still lack deeper awareness of its implications for learning, work, and career development.

The significant effect of GenAI Use on Future Career Perception indicates that practical experience with GenAI tools can contribute to students' awareness of future work practices. However, the relatively weak coefficient suggests that using GenAI tools is not sufficient by itself. Tool use becomes more meaningful when supported by AI Literacy. This explains why the indirect effect through AI Literacy was stronger than the indirect effect through GenAI Use. In practical terms, students may use ChatGPT, Copilot, Gemini, or other GenAI tools for assignments, but career readiness depends more on whether they understand how to use these tools critically and ethically.

The rejected direct relationship between Digital Literacy and Future Career Perception is also meaningful. It implies that students may be digitally competent but not necessarily career-ready in relation to AI-driven changes. Digital literacy helps students operate in digital

environments, but AI literacy helps them interpret the role of AI in future professions. Therefore, higher education institutions should not assume that digitally active students are automatically prepared for AI-related career transformation.

These results have practical implications for universities. AI literacy should be integrated into curriculum design, academic guidance, and career preparation programs. Universities need to help students develop competencies in prompt formulation, AI output evaluation, ethical AI use, data privacy awareness, academic integrity, and responsible decision-making. Career services should also include AI-related employability skills so that students can better understand how GenAI may affect future job roles, productivity, and professional expectations.

In summary, the model confirms that AI Literacy is the key mechanism linking Digital Literacy to GenAI Use and Future Career Perception. Digital Literacy provides the foundation, GenAI Use reflects behavioral engagement, and AI Literacy functions as the critical bridge between technological competence and future career readiness.

CONCLUSION

This study examined the influence of Digital Literacy and AI Literacy on GenAI Use and Future Career Perception among university students in Samarinda, Indonesia. The findings show that students generally demonstrated moderately high levels of Digital Literacy and AI Literacy, while GenAI use was already widespread in academic activities, particularly for text-based purposes such as writing, editing, summarizing, and supporting learning tasks. These findings indicate that GenAI has become part of students' academic practices and that higher education institutions need to respond to this development through structured literacy and guidance programs.

The results of the structural model confirm that Digital Literacy plays an important foundational role in shaping AI Literacy and GenAI Use. Students with stronger digital literacy were more likely to develop AI-related understanding and to use GenAI tools in their academic activities. However, Digital Literacy did not have a significant direct effect on Future Career Perception. This finding suggests that general digital competence alone is not sufficient to shape students' confidence and readiness for an AI-driven labor market. Digital skills become more meaningful for future career perception when they are transformed into more specific AI-related knowledge and awareness.

AI Literacy emerged as the most important construct in this study. It had a significant effect on Future Career Perception and GenAI Use, and it also mediated the relationship between Digital Literacy and Future Career Perception. This indicates that students who understand AI concepts, AI limitations, ethical issues, and practical applications are more likely to perceive future career opportunities positively. AI Literacy therefore functions as a critical bridge between general digital competence and students' readiness to face future changes in employment, workplace practices, and professional competencies.

GenAI Use also had a significant effect on Future Career Perception, although its influence was weaker than that of AI Literacy. This finding implies that using GenAI tools can

help students become more aware of future work practices and the relevance of AI in professional contexts. However, tool use alone is not enough to build strong career readiness. Students need to be equipped with the ability to evaluate AI-generated content, formulate appropriate prompts, recognize bias and misinformation, maintain academic integrity, and use AI responsibly. Therefore, higher education institutions should not only encourage the use of GenAI but also ensure that students understand how to use it critically, ethically, and productively.

The findings have several practical implications. Universities should integrate AI literacy into curriculum design, learning activities, academic writing guidance, and career development services. AI literacy programs should include basic AI concepts, responsible GenAI use, prompt formulation, output verification, data privacy, academic integrity, and the implications of AI for employability. Lecturers and academic institutions also need clear policies and practical guidelines to help students use GenAI as a learning support tool rather than as a substitute for critical thinking and independent academic work.

This study has several limitations. First, the research used a cross-sectional survey design, so it cannot fully explain changes in students' literacy, GenAI use, and career perception over time. Second, the data were based on self-reported responses, which may reflect students' perceptions rather than their actual competence or behavior. Third, the study was conducted among students in Samarinda, so the findings may not fully represent students in other regions with different digital infrastructure, academic cultures, and levels of exposure to AI. Fourth, this study did not examine differences across specific GenAI platforms, academic disciplines, or levels of study in detail.

Future research is recommended to use longitudinal designs to examine how students' AI literacy, GenAI use, and career perceptions develop over time. Further studies may also combine survey data with interviews, performance-based assessments, or classroom observations to obtain a deeper understanding of students' actual AI competence and responsible use practices. Comparative studies across regions, universities, disciplines, and student groups would also be useful to identify contextual factors that influence GenAI adoption and AI-related career readiness. In addition, future research may examine moderating variables such as academic discipline, semester level, socioeconomic background, prior digital experience, and institutional AI policy.

Overall, this study concludes that AI Literacy is the key mechanism linking Digital Literacy, GenAI Use, and Future Career Perception. Digital Literacy provides the foundation, GenAI Use reflects behavioral engagement, and AI Literacy strengthens students' ability to interpret, evaluate, and apply AI meaningfully for academic and career purposes. Strengthening AI literacy in higher education is therefore essential to prepare students not only to use GenAI tools, but also to adapt responsibly and confidently to an AI-driven future labor market.

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